



# **National Aeronautics and Space Administration**

**Goddard Earth Science Data Information and  
Services Center (GES DISC)**

## **README Document for**

**MODIS Land Cover Dynamics Yearly L3 1km MAIRS Region**

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# 1.0 Introduction

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This document provides basic information for processing and using MODIS Terra+Aqua combined Land Cover Dynamics Yearly L3 1km over MAIRS region.

The dataset consists of four parameters of the land cover dynamics, providing estimates of the timing of vegetation phenology. Each parameter has two modes (or cycles). The products are generated for regional climate studies associated to the land cover/land use changes over Monsoon Asia regions.

## 1.1 Dataset Description

The datasets (MCD12Q2\_MAIRS\_<param>.005) in this collection were processed from MODIS standard product: MCD12Q2.005 (Land Cover Dynamics Yearly L3 Global 500m SIN Grid, collection-5) downloaded from USGS and NASA Land Processes Distributed Active Archive Center (LP DAAC). The <param> in the dataset name is one of four land cover dynamics parameters:

INC: Onset Greenness Increase

DEC: Onset Greenness Decrease

MAX: Onset Greenness Maximum

MIN: Onset Greenness Minimum

The short and long names of corresponding four products are:

**MCD12Q2\_MAIRS\_INC.005:** MODIS/Terra+Aqua Land Cover Dynamics (Greenness Increase) L3 Yearly 1km MAIRS Region

**MCD12Q2\_MAIRS\_DEC.005:** MODIS/Terra+Aqua Land Cover Dynamics (Greenness Decrease) L3 Yearly 1km MAIRS Region

**MCD12Q2\_MAIRS\_MAX.005:** MODIS/Terra+Aqua Land Cover Dynamics (Greenness Maximum) L3 Yearly 1km MAIRS Region

**MCD12Q2\_MAIRS\_MIN.005: MODIS/Terra+Aqua Land Cover Dynamics (Greenness Minimum) L3 Yearly 1km MAIRS Region**

## 1.2 Algorithm Background

The original data (MCD12Q2.005) are stored in 10x10 degree tiled files in the sinusoidal projection, containing four land cover dynamic parameters, NBAR EVI values and QC flag. In order to integrate the data into NASA GES DISC's online visualization system, Giovanni, and make the data extraction easier for any given point or section within MAIRS study region, the data files were mosaiced and re-projected onto equidistant cylindrical projection (or Equi-rectangular projection). The output data file covers the entire Asian Monsoon region (0° – 60°N, 60°E – 150°E). Each output data file contains only one parameter and subsampled to 1km resolution with nearest point method in order to reduce the file size for having better performance of the online visualization system.

The data sets are processed by using MODIS Re-projection Tool (MRT) release 4.0 from the LP DAAC. First, the MODIS Land Cover Dynamics Yearly L3 Global 500m SIN Grid, collection-5 (MCD12Q2.005) data were downloaded for all tiles over the Asian monsoon region. Then, programs **mrtmosaic** and **resample** were run under batch mode with the following setting:

```
SPATIAL_SUBSET_TYPE = INPUT_LAT_LONG
SPATIAL_SUBSET_UL_CORNER = ( 60.0 60.0 )
SPATIAL_SUBSET_LR_CORNER = ( 0.0 150.0 )
RESAMPLING_TYPE = NN (nearest point)
OUTPUT_PROJECTION_TYPE = ER (equi-rectangular projection)
OUTPUT_PROJECTION_PARAMETERS = (6371007.181 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0
0.0 0.0 0.0 0.0 0.0 0.0 0.0)
OUTPUT_PIXEL_SIZE = 1000
DATUM = NoDatum
```

MCD12Q2 is produced once a year with 24 months of input data (i.e., the 12 months of interest data bracketed by six month's data on either side). For each growth cycle, four phenological transition dates are recorded. The corresponding phenological transition dates are defined as the onset of greenness increase (A'), the onset of greenness maximum (B'), the onset of greenness decrease (C'), and the onset of greenness minimum (D') (details in MOD12Q2 product user's guide).

The original values of land cover dynamics are "Days since Jan 1, 2000". It makes difficulty to compare data between different years. Therefore we have converted the data value to "Days since Jan 1" of each year (DOY) after extracted from the original file.

## 1.3 Data Quality

When generating MCD12Q2\_MAIRS\_<param>.005, the near point method is used for re-sampling. The data quality of each grid point is remained as the input data.

In Giovanni, no quality filtering is performed. Therefore, all valid data points at all quality levels are participated in analysis.

For more information about validation and data quality of the input data, please read MODIS land cover dynamics product user's guide ([http://www-modis.bu.edu/duckwater1/mod12q2/doc/MOD12Q2\\_V4\\_user\\_guide.doc.pdf](http://www-modis.bu.edu/duckwater1/mod12q2/doc/MOD12Q2_V4_user_guide.doc.pdf) ).

The Algorithm Technical Background Document (**ATBD**) of the original products can be found from the MODIS land product algorithm web page:

[http://modis.gsfc.nasa.gov/data/atbd/land\\_atbd.php](http://modis.gsfc.nasa.gov/data/atbd/land_atbd.php)

## 1.4 Data Disclaimer

The dataset covers Monsoon Asia region (0° – 60°N, 60°E – 150°E) only, and was derived from MODIS standard product MCD12Q2.005. The data are not copyrighted and are open to all for both commercial and non-commercial uses. If you use the data for a publication (research or otherwise), or for any other purpose, we request you to acknowledge data producer (refer to MODIS Land Cover Dynamics Product User's Guide) and to include the following acknowledgement:

“The data used in this effort were acquired from NASA Goddard Earth Sciences (GES) Data and Information Services Center (DISC)”

We would appreciate receiving a copy of publication reference. Please email to [gsfc-help-disc@lists.nasa.gov](mailto:gsfc-help-disc@lists.nasa.gov)

## 2.0 Data Organization

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*Each data file contains two scientific datasets, which are two modes of land cover dynamics parameter at 1km resolution for a specific year.*

### 2.1 File Naming Convention

The data files are named in accordance to the following convention:

MAIRS\_<product>\_L3\_<version>\_<YYYYMMDD>.hdf

Where:

<product> = MCD12Q2\_<param> for a parameter

<version> = processing version, the current version is v005

<YYYYMMDD> = year, month, day

Filename Example: MAIRS\_ MCD12Q2\_INC\_L3\_v005\_20010101.hdf

The date string in a file denotes the beginning date of a year.

## 2.2 File Format and Structure

Files are in the Hierarchical Data Format Version 4 (HDF-4) format, developed at the National Center for Supercomputing Applications <http://www.hdfgroup.org/>.

## 2.3 Key Science Data Fields

*There are two Science Data Fields in each data file.*

Read section 3.3 for details.

# 3.0 Data Contents

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## 3.1 Dimensions

*YDim:MOD12Q1 = 6672;*

*XDim:MOD12Q1 = 10008 ;*

## 3.2 Global Attributes

The Global attributes list spatial coverage and resolution information as in the following example:

```
// global attributes:  
:Map_Projection = "Equidistant Cylindrical" ;  
:Westmost_Longitude = 60.f ;  
:Eastmost_Longitude = 150.f ;  
:Southmost_Latitude = 0.f ;  
:Northmost_Latitude = 60.f ;
```

```

:Latitude_Units = "degrees South" ;
:Longitude_Units = "degrees East" ;
:Longitude_Step = 0.0089919996f ;
:Latitude_Step = -0.0089919996f ;
:First_Point_Latitude = 60.f ;
:First_Point_Longitude = 60.f ;

```

### 3.3 Products/Parameters

Each MCD12Q2\_MAIRS\_<param>.005 data file contains two science data fields as listed in the following table:

SDS_ShortName	SDS_LongName	Unit	Data Type	Fill Value
Onset_Greenness_<var> .Num_Modes_01	Yearly Onset Greenness <var> Mode-1	DOY	float	32767
Onset_Greenness_<var> .Num_Modes_0	Yearly Onset Greenness <var> Mode-2	DOY	float	32767

Where, <var> are:

- Increase in MCD12Q2\_MAIRS\_INC.005
- Decrease in MCD12Q2\_MAIRS\_DEC.005
- Maximum in MCD12Q2\_MAIRS\_MAX.005
- Minimum in MCD12Q2\_MAIRS\_MIN.005

## 4.0 Options for Reading the Data

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### 4.1 Command Line Utilities

#### 4.1.1 ncdump

The ncdump tool can be used as a simple browser for HDF data files, to display the dimension names and sizes; variable names, types, and shapes; attribute names and values; and optionally, the values of data for all variables or selected variables in a netCDF file. The most common use of ncdump is with the -h option, in which only the header information is displayed.

```
ncdump [-c|-h] [-v ...] [[-b|-f] [c|f]] [-l len] [-n name] [-d n[,n]] filename
```

Options/Arguments:

[-c]	Coordinate variable data and header information
[-h]	Header information only, no data
[-v var1[,...]]	Data for variable(s) <var1>,... only data
[-f [c f]]	Full annotations for C or Fortran indices in data
[-l len]	Line length maximum in data section (default 80)
[-n name]	Name for netCDF (default derived from file name)
[-d n[,n]]	Approximate floating-point values with less precision filename File name of input netCDF file

Note: the ncdump tool will only display variables whose ranks are great than 1. In other words, you will not see one dimensional vectors using this tool.

In general, the ncdump program can be found in bin directory of the HDF installation area.

Consult your local computer system administrator for the specifics.

### 4.1.2 hdp

The hdp utility is a HDF dumper developed by HDF group at NCSA.

Usage: hdp [-H] command [command options] <filelist>

-H Display usage information about the specified command.  
If no command is specified, -H lists all commands.

Commands:

list	lists contents of files in <filelist>
dumpsds	displays data of SDSs in <filelist>
dumpvd	displays data of vdatas in <filelist>.
dumpvg	displays data of vgroups in <filelist>.
dumprig	displays data of RIs in <filelist>.
dumpgr	displays data of RIs in <filelist>.

For more information, please visit the NCSA web site: <http://hdf.ncsa.uiuc.edu/hdp.html>

### 4.1.3 read\_hdf

The read\_hdf tool is a command-line utility developed by GES DISC. It allows a user to browse the file structure and display data values if desired.

Command line syntax:

read\_hdf [-l] | [[-i | -d] [-a <output> | -b <base>.\*.bin ]] filename

Options/Arguments:

[-i]	-- run in interactive mode (default), or
[-l]	-- list a tree of file objects, or

[-d] -- dump all HDF object types (no filtering)  
[-a <output>] -- ASCII output file name (default is <filename>.txt)  
[-b <base>] -- base binary output file name (default is <filename>)  
creates two files per HDF object:  
<base>.\*.met for metadata, and <base>.\*.bin for binary data  
(default output to stdout)  
filename -- name of the input HDF file

The source code is written in C language and can be obtained from GES DISC ftp server:  
[ftp://disc1.gsfc.nasa.gov/software/aura/read\\_hdf](ftp://disc1.gsfc.nasa.gov/software/aura/read_hdf)

## 4.2 HDFView

The HDFView is java based GUI application visual tool for browsing and editing NCSA HDF4 and HDF5 files. Using HDFView, you can:

- (1) view a file hierarchy in a tree structure
- (2) create new file, add or delete groups and datasets
- (3) view and modify the content of a dataset
- (4) add, delete and modify attributes
- (5) replace I/O and GUI components such as table view, image view and metadata view

More information can be found at the official [HDFView](http://www.hdfgroup.org/hdf-java/html/hdfview/) web site (<http://www.hdfgroup.org/hdf-java/html/hdfview/>). There is an add-on [plug-in](#) for handling HDFEOS data specifically.

## 4.3 GrADS

The Grid Analysis and Display System (GrADS) is an interactive desktop tool developed and maintained by Institute of Global Environment and Society (IGES). GrADS supports many data file formats, including binary (stream or sequential), GRIB (version 1 and 2), NetCDF, HDF (version 4 and 5), and BUFR (for station data). Software download and more information and usages can be found at the GrADS web site: <http://www.iges.org/grads/grads.html>

To read the data by using GrADS, it needs to have a GrADS descriptor file that documents data source, structure, etc. For example, the following is the contents of a descriptor file, save it to a file "lcd.ctl"

```
dset <datapath>/MAIRS_MCD12Q2_INC_L3_v005_20010101.hdf
options yrev
title "MODIS Land Cover dynamics data 1km over MAIRS region"
dtype hdfsds
undef 32767 _FillValue
xdef 10008 linear 60.0 0.008992
ydef 6672 linear 0.008992
zdef 1 levels 1000
```

```
tdef 366 linear 1Jan2001 1yr
vars 2
Onset_Greenness_Increase.Num_Modes_01=>m1 0 y,x Mode 1
Onset_Greenness_Increase.Num_Modes_02=>m2 0 y,x Mode 2
endvars
```

The following is an example to read and plot an image by using GrADS:

```
'open lcd.ctl'
'set lon 122 126'
'set lat 46 49'
'set gxout grfill'
'set mpdset hires'
'set poli on'
'set clevs 90 100 110 120 130 140 150 160 170'
'd m1'
title='MODIS Onset greenness increase 2001'
'draw title 'title'
'run cbar'
```

## 5.0 Data Services

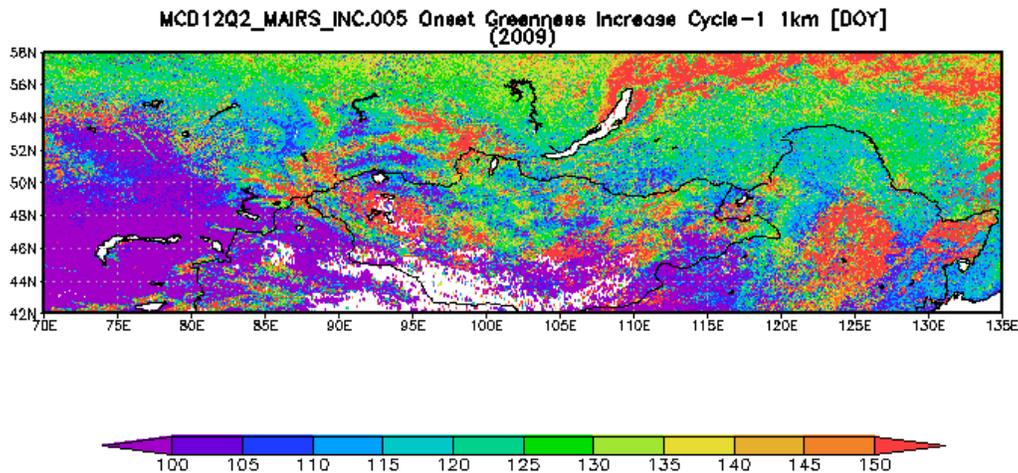
---

### 5.1 Access and analysis through Giovanni

Giovanni (GES DISC Interactive Online Visualization ANd aNalysis Infrastructure) is a Web-based application that provides a simple and intuitive way to visualize, analyze, and access data. The MODIS land cover dynamics data sets MCD12Q2\_MAIRS\_<param >.005 have been integrated into the Giovanni system and are available through the portal named mairs\_yearly:

[http://gdata1.gsfc.nasa.gov/daac-bin/G3/gui.cgi?instance\\_id=mairs\\_yearly](http://gdata1.gsfc.nasa.gov/daac-bin/G3/gui.cgi?instance_id=mairs_yearly)

The following image is land cover dynamics (onset greenness increase cycle-1) at 1km resolution of 2009 over northern Asia generated by using Giovanni. The unit of the data is day-of-year.



## 5.2 Direct FTP:

The data are available on anonymous FTP site at:

[ftp://neespi.gsfc.nasa.gov/data/s4pa/Land\\_Water\\_Cover/](ftp://neespi.gsfc.nasa.gov/data/s4pa/Land_Water_Cover/)

## 6.0 More Information

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MODIS Land Cover Dynamics Product User's guide:

[http://www-modis.bu.edu/duckwater1/mod12q2/doc/MOD12Q2\\_V4\\_user\\_guide.doc.pdf](http://www-modis.bu.edu/duckwater1/mod12q2/doc/MOD12Q2_V4_user_guide.doc.pdf)

The Algorithm Technical Background Document (ATBD):

[http://modis.gsfc.nasa.gov/data/atbd/land\\_atbd.php](http://modis.gsfc.nasa.gov/data/atbd/land_atbd.php)

Berrick, S., Leptoukh, G., Farley, J., & Rui, H. (2009). Giovanni: A Web services workflow-based data visualization and analysis system. *IEEE Trans. Geosci. Remote Sens.*, 47(1), 106-113.

Any question regarding data, please contact: [gsfc-help-disc@listserv.gsfc.nasa.gov](mailto:gsfc-help-disc@listserv.gsfc.nasa.gov).

## 7.0 Acknowledgements

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